

# Photonic Sensor for Nondestructive Testing of Composite Overwrapped Pressure Vessels, Phase I

Completed Technology Project (2009 - 2009)



## Project Introduction

Los Gatos Research proposes to develop a photonic sensor instrumentation, capable of monitoring distributed load and acoustic emission (AE) for rapid inspection of damages in composite overwrapped pressure vessels (COPV). Our novel sensor technology offers a number of advantages including sensor compactness and lightweight with multiplexing capability for load and AE for monitoring and characterizing damages in advanced composite structures and components. We achieve this by employing Bragg grating sensor arrays and using a novel interrogation technique combined with state-of-the-art AE method to detect and pinpoint composite defects in these structures. In Phase I, we will demonstrate the sensor's capability to measure loads and acoustic emission in a composite structure in comparison with conventional piezoelectric type AE sensors. In addition, we will develop a damage grading methodology to predict the presence, location, severity of damages in the COPV. In Phase II, the grating sensors, interrogation system, and diagnostic software will be integrated into an automated system, capable of measuring and correlating the load history, acoustic emission activity, and determining the severity of damages and their location in the COPV.

## Anticipated Benefits

Advances in load and acoustic emission measurement technology have immediate applications in civil engineering for monitoring and evaluating damages, corrosion, and fatigue in steel and concrete structures such as bridges, freeways, and buildings. High frequency ultrasonic signal detection method development can be utilized in ultrasonic testing, medical imaging, and other non-destructive testing technology. LGR's BGA technology development can be readily incorporated into current fiber optics and optical cross-connect technology for next-generation telecommunication applications. Optical fiber technology provides significant advantages for advanced aerospace platforms because they are lightweight, immune to electromagnetic wave interference, rugged, and do not produce short circuits or ground loops. The development of an intelligent fiber optic sensors for damage diagnostic has the potential to enhance reliability, enable lower cost, and facilitate more effective structural health management and nondestructive evaluation of NASA's aircraft and spacecraft components and systems. The Bragg grating array sensor device LGR proposed to develop for Phase I will greatly enhance NASA efforts to develop state-of-the-art, compact, low-cost, waveform-based, quantitative strain and acoustic emission sensing technology for load and damage monitoring of advanced structures.



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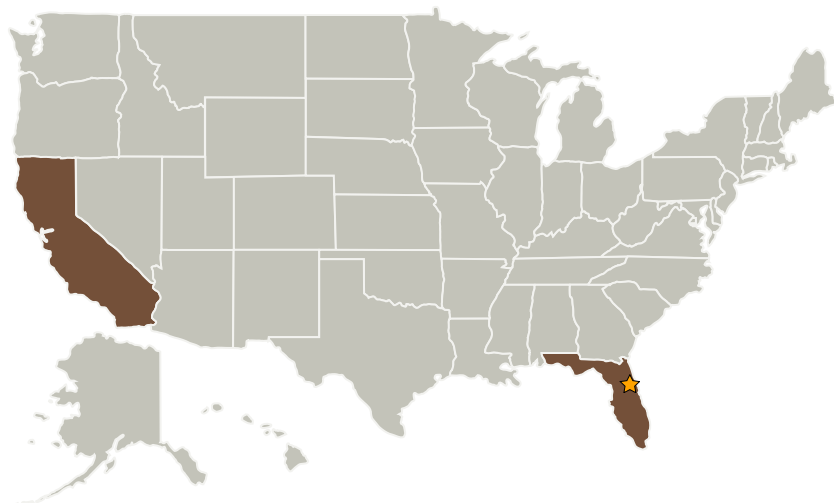
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## Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★ Kennedy Space Center(KSC)	Lead Organization	NASA Center	Kennedy Space Center, Florida
Los Gatos Research	Supporting Organization	Industry	Mountain View, California

## Primary U.S. Work Locations

California	Florida
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## Organizational Responsibility

**Responsible Mission Directorate:**

Space Technology Mission Directorate (STMD)

**Lead Center / Facility:**

Kennedy Space Center (KSC)

**Responsible Program:**

Small Business Innovation Research/Small Business Tech Transfer

## Project Management

**Program Director:**

Jason L Kessler

**Program Manager:**

Carlos Torrez

**Project Manager:**

Stan O Starr

**Principal Investigator:**

An-dien Nguyen

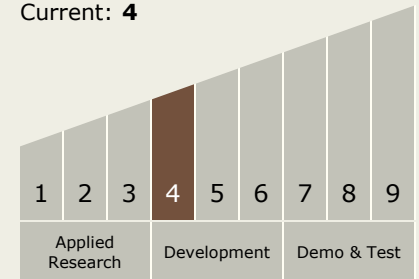
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## Technology Maturity (TRL)

Start: 4  
Current: 4



## Technology Areas

### Primary:

- TX14 Thermal Management Systems
  - └ TX14.3 Thermal Protection Components and Systems
    - └ TX14.3.5 Thermal Protection System Instrumentation